Human Language and Machine Language

by Robert Bedrosian*

For Susan Calvin

> "Detection is, or ought to be, an exact science, and should be treated in the same cold and unemotional manner. You [Watson] have attempted to tinge it with romanticism, which produces much the same effect as if you worked a love-story or an elopement into the fifth proposition of Euclid."
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> Sherlock Holmes, criticising Dr. Watson's writing style, from *The Sign of the Four*, by Arthur Conan Doyle (1890).

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Notes

Anyone who has enjoyed a good book knows the pleasure it produces. One can exist in that lovely space and consider it a haven from the "real world." The book in question need not be fiction, either. Non-fictional works also create worlds, worlds of the mind. It is language that makes this possible.

Human language, spoken and written, is one form of communication between humans, which attempts a symbolic representation of our reality. Other forms of communication include sign language/gestures, uttering cries, and drawing pictures. Spoken and written words may be interpreted differently and marshalled to produce varieties of reality. And thus language stands *almost* as a kingdom apart. *Almost* is the keyword here, since written or spoken descriptions, intentionally or unintentionally, are subjective. Invariably they will be human-centric and, accordingly, limited.

Some people seem to live almost entirely in a world of words, locked inside what Max Mueller called "the disease of language" (1). So completely in the grip of these symbols are many of us, that we communicate with ourselves using internal conversations "thinking in words." We are born and raised into a world of words, "forced" into it by our societies. It is not a deliberate choice that we make. Yet if we want to succeed in many human endeavors, we need to read, write, and speak effectively.

But words do fail. All of us have said: "There are no words to describe it!" And indeed, since words are only symbolic, they cannot describe many things, such as physical feelings, or emotions, though of course the attempts are made. In any case, these worlds of words are our human creations, and they themselves have the limiting factors of our human condition.

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Currently, there are more than 6,000 languages and dialects in use among humans. In addition, there are many thousands of extinct or "dead" languages. It is noteworthy that these languages are all translatable into other languages. Each has its own syntax, structure, and tonalities, but they are mostly the same from the standpoint of functionality. English and Chinese, for example, despite many differences, do not express radically different concepts. They are human languages expressing human concepts.

When it comes to machine languages, we need to bear in mind that these computer languages are creations of humans. Indeed, the computer itself could be studied profitably for what it says about human mentation and language concepts, and our attempts to create something better than ourselves. Fortunately, there are not as many computer languages as spoken human languages—but there are still enough so that some are now described as "dead" or "legacy" languages. Nonetheless, computer languages like Assembler and Cobol, are not "dead" in the same way that hieroglyphic Egyptian is dead. Also, importantly, though the languages differ in many ways, from the standpoint of functionality they are mostly the same.

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Much of the material in this essay derives from personal experiences with languages. From 1980-2001, I learned and/or used various mainframe computer languages. Some of them (such as RPG, Fortran, Assembler, and Cobol) were learned in programming school in 1980. Other mainframe languages (such as CICS and DB2) were learned on the job during the next twenty years. When the personal computer became widespread in the early 1990s, new languages—the languages of the day—also were learned.

Prior to this, from 1968-1979, I had learned a variety of human languages, aiming to become a historian of the ancient Near East. By the time I received a Ph.D. (1979), I had learned or studied French, Russian, several forms of Iranian (Achaemenid cuneiform, Parthian, Pahlavi), and Armenian (Classical and Modern). My native language is English.

As a result of these experiences, for much my adult life I've wondered about similarities between human and computer languages. Comparing and contrasting the two has teased me for forty years. Since my knowledge of both is of a practical kind, rather than theoretical, direct observation and analogous reasoning have guided me. This has been augmented by reading the works of some 19th-20th century pioneers who have written about language, such as Edward Burnett Tylor, Charles Darwin, Franz Boas, and A. L. Kroeber (2), as well as many thought-provoking articles about human and computer languages at Wikipedia (3).

To highlight some differences between the approach of humans and machines (with their languages *and* methods) we will create a vignette to see how humans and machines might address several activities which occur in it, in particular: 1. description of the data; 2. data storage and retrieval; 3. data transformation; and 4. interpretation of the data.

A Woman Rushes into a Room

1. Description of the data.

A woman, apparently disturbed, rushes into a room and sinks into an armchair. She is breathing laboriously, shaking her head and seems agitated. Tears begin to stream down her face. She dabs at them with a handkerchief, shaking her head and moaning. She blows her nose and looks around the room frantically.

Such is the description which a human observer—such as the present author—might make. In the above description, the words "apparently" and "seems" are significant keywords, since it is not clear from the externals what the problem is.

How might a machine characterize the same scene?

An advanced machine might remotely examine the woman internally and externally. It would determine her general health, examing all major systems including heart condition, blood pressure, vision, chemistry (such as imbalances), and teeth, among other medical factors. It might discover things that the woman herself is unaware of. For example, she may be pregnant. The machine notes these factors and records them precisely with a timestamp. The same factors (and/or others) might be queried at intervals to observe changes.

There is quite a difference here between human and machine approaches. The machine description is a collection of discrete, or separate, verifiable facts, and when the time comes to inquire on them, they may be taken as separate parameters and/or combined. The human description already is operating on perceptions and trying to make "sense" based on them, trying to connect the dots, to make a narrative or story. Based solely on externals, what the human eye can observe, the woman seems to be unhappy and upset. In the very description of the data, an "emotional" aspect has been introduced by the way humans use language and make observations, and perhaps by nature of the language itself.

2. Data storage and retrieval. Differences in data storage also are substantial. Humans, in an earlier era, might rely on their memories. But in a literate society, and in this particular case, the description would be committed to writing. More than likely the document would consist of direct observations followed by inferences drawn from the data. Depending on the author's abilities, and on what the reader might be looking for, the document could be characterized as well-written, useful, precise, etc. It remains, however, a symbolic representation of the reality it seeks to portray. If the author is talented, you might "see" the scene being described. But you are seeing it in the theater of your own mind, where the symbolic language gets transformed into something lifelike.

Computer languages actually have available to them as part of their operational design, what is called file input and output, that is, the language can write to files and databases and read from them. Thus, for the machine, file writing may be considered an integral part of the language itself, not something separate. With this facility, computer languages have the ability to add, inquire on, update, and delete information, as well as to search and sort the data. This is quite different from the "human style" where the recording is a separate process done with paper and pen or keyboard. Human languages, unlike computer languages, do not have storage and retrieval features built into them. A machine, after making a detailed collection of data about the woman's medical condition would record this information in files and tables. It could augment this with a video of the entire scene, as well as physical and environmental measurements of the room.

When it comes to retrieving the information, the machine will produce the same data each time. It will not have forgotten or altered the facts as our human minds tend to do. In the present case, where the human has written a description of the event, that description surely will be retrieved as it was written—one document, with all its data bound together.

3. Display/Transformation of the Data. The machine is able to produce more than just one result. Surely, it could be asked to retrieve *one* specific piece of information. But it could also produce alternate "views" of the data, that is, it could show the results of data queried for a *group* of parameters, including temperature of the room, the woman's blood pressure, the pollen count, etc. It can arrange the data into displays with charts and graphs.

4. Interpretation of the Data. The mystery of the "disturbed woman" is this: the woman is suffering from allergies. Pregnant or not, her labored breathing and the tears rolling down her cheeks are her reactions to pollen and mold spores in the air. Her rushing into the room was because she was eager to get home. Her looking around the room "frantically," was misperception by the human observer. In other words, the various activities of the "disturbed woman" were not actually connected into a single causal narrative.

Imagine now what a human analyst/observer might do with *some* of the machine's data. On top of the already questionable foundation—that the woman's tears were from emotional distress rather than allergy—the human could create a variety of fantastic scenarios, all of them fitting the data, but all of them incorrect. The human observer might conclude that the woman may be panicking because she just learned that she is pregnant. But the pregnancy may have nothing to do with the current situation. She may not know about the pregnancy, and, if she did, she might be delighted instead of miserable.

Thus in the analysis of the data, as in the collection and display of the data, machines, unquestionably, perform more reliably than their human creators.

What is it that humans are adding to the description and to the analysis that is lacking in the machine approach? Is it something in human language itself?

Emotionally Yours

The mysterious element that is in human language is there because it is dominant in the animal itself: emotion.

Perhaps initially, symbolic language transformed animal attacks into verbal attacks. One can snarl, bark, and bite using language, too. Instead of slashing at our enemies with our claws and biting with our teeth, we can shout threats at them. *Orally*, humans can manipulate words to present the same statement in hurtful or insulting or flattering language, based on the words chosen and the inflections given to them. Furthermore we can *write*, and, as any good lawyer will demonstrate, turn one thing into its opposite, almost credibly. It may seem as though this were a symbolic version of a physical attack. However, there is no reason to assume that our violent animal ways gave way to violent expression as a "civilizing" substitute for physical attack over time. Emotions probably gave birth to language in the first place.

Let us briefly sumarize the views on the origin and/or development of language of four influential investigators: Darwin, Tylor, Boas, and Kroeber.

Readers who enjoy a good laugh, should have a look at Charles Darwin's sole foray into human psychology, The Expression of the Emotions in Man and Animals [at Internet Archive]. This classic work, originally published in 1872, deals with the biological aspects of emotional life. Wild animals, humans, and their pets are shown in various situations in many unforgettable photographs and illustrations. Not only are the facial expressions often almost the same, but the physiological reactions are unmistakably related. Darwin found parallels for many shared emotions, such as happiness, sadness, fear, anger, surprise and disgust.

Darwin believes that language originated from breeding cries.

E. B. Tylor, in chapters 4-6 of his *Anthropology*, describes some commonalities of language among humans and other creatures, what he calls "natural language." At an early and lower level of sophistication, this consists of cries and gestures:

> "One kind of sounds used by men as signs, consists of emotional cries or tones. Men show pain by uttering groans as well as by distortion of face; joy is expressed by shouts as well as by jumping; when we laugh aloud, the voice and the features go perfectly together. Such sounds are gestures made with the voice, sound-gestures, and the greater number of what are called interjections are of this class. By means of such cries and tones, even the complicated tempers of sympathy, or pity, or vexation, can be shown with wonderful exactness. " p. 120.
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> ...We can all do this, and what is more, we do it without reference to the meaning of the words used, for emotion can be expressed and even delicately shaded off in pronouncing mere nonsense-syllables. For instance, the words of an Italian opera in England are to a great part of the audience mere nonsense-syllables serving as a means of musical and emotional expression." (p. 121).
>
> p. 122: Here a very interesting question arises... How far are the communications of the lower animals, by their actions and sounds, like this natural language of mankind? Everyone who attends to the ways of beasts and birds is sure that many of their movements and cries are not made as messages to one another, but are merely symptoms of the creature's own state of mind; for instance, when lambs frisk in the meadow, or eager horses paw in the stable, or beasts moan when suffering severe pain. Animals do thus when not aware that any other creature is present, just as when a [123] man in a room by himself will clench his fist in anger, or groan in pain, or laugh aloud. When gestures and cries serve as signals to other creatures, they come nearer to real signs. The lower animals as well as man do make gestures and cries which act as communications, being perceived

> by others, as when horses will gently bite one another to invite rubbing, or rabbits stamp on the ground and other rabbits answer, and birds and beasts plainly call one another, especially males and females at pairing-time. So distinct are the gestures and cries of animals under different circumstances, that by experience we know their meaning almost certainly. Human language does not answer its purpose more perfectly than the hen's cluck to call her chickens, or the bellow of rage with which the bull, tossing his head, warns off a dog near his paddock. As yet, however, no observer has been able to follow the workings of mind even in the dog that jumps up for food and barks for the door to be opened (4).

Franz Boas believes that spoken human language arose from the gestures and cries of our early ancestors. In speaking of communication among animals, he wrote:

> Animals convey their emotions by means of cries, touch, and visible movements, and in so far as these are related to experiences exciting fear, anger, or pleasure they are significant. The cry of the leader of a herd serves as a warning of approaching danger. The display of the plumage of the male bird affects the female. The touch of the antennae of an ant conveys a message upon which its comrade reacts. Some animals have a considerable number of distinct cries with which they react to different emotional states or by which they call their fellows. The grimaces of the monkey indicate the nature of its mental excitement. (5)
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> ...Man uses movements and sound in the same manner, but in addition to vague expressions there are others by means of which specific experiences are indicated. Both animal and man turn their heads in the direction of an object exciting their attention, but in addition to this, man has the free use of his hands, which point and follow the movement of the object. Emotional attitudes are accompanied by innervations corresponding to actions. When the stimulus is strong enough these follow, but when weak they lead only to expressive movements, such as a call, shrinking away from some object, or a hostile repulsion. (6)

Kroeber sees impulsive desires at the root of language and also notes: "...All social creations—institutions, beliefs, codes, styles, grammars—prove on impartial analysis to be full of inconsistencies and irrationalities. They have sprung not from a premeditated system of weighed or reasoned choices but from impulsive desires, from emotionally colored habits, or from "accidents" happening in some other part of the culture" (7).

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Thus even at the dawn of Physical and Cultural Anthropology as disciplines, the late 19th and early 20th centuries, the pioneering figures cited above regarded human language as originating in warning barks and mating calls, and fundamentally emotional.

Delusionally Yours

We noted in an earlier essay that humanity, by its nature as a species, is prone to delusions. We sleep about 1/3 of our lives, during which period we are bombarded by images of real and fantastic things. These are dreams of the *night*. But during the *day* we day-dream; and for entertainment, we may watch videos or read. When humanity advanced to the point of detailed communication, is it any wonder that the medium, too, would have delusional aspects? Moreover, in addition to the "normal" delusional aspects, language can be used intentionally to create delusions by activities such as lying, deception, and propaganda.

Delusional tendencies also may be seen in our evaluation of data. We want to connect the dots and make a story or tale out of everything, even when such treatment is not appropriate.

Delusional tendencies also are part of the native human storage and retrieval of the data. In our example of the disturbed woman, the human observer/recorder was able to use writing to make the observations. However, it is important also to consider "native storage" that is, human recollection without paper and pencil and files. Our distant human ancestors did not write, they remembered. Then, as now, storage of the information appears to be an associative process, putting "like with like," meaning that similar things are grouped together. Reaching into our memories for a particular thing also seems to retrieve some aspects of the group-mates it was stored with. For that reason, the recollection of the "original" event—which we were searching for—may end up getting tinged with the hues of entities having some similar attributes (8).

In the concluding chapter of *Primitive Culture* Tylor discusses the "development" of language:

> "The development of language between its savage and cultured stages has been made in its details, scarcely in its principle. It is not too much to say that half the vast defect of language as a method of utterance, and half the vast defect of thought as determined by the influence of language, are due to the fact that speech is a scheme worked out by the rough and ready application of material metaphor and imperfect analogy, in ways fitting rather the barbaric education of those who formed it, than our own. Language is one of those intellectual departments in which we have gone too little beyond the savage stage, but are still as it were hacking with stone celts and twirling laborious friction-fire (9)."

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Let us try to look into the future, at ourselves as a species, and at language. Let us imagine a "non-organic" human, not made of flesh and blood but of machine parts. Our machine descendants will communicate electronically using the language(s) and methods of machines. In such a world, there would be no need for spoken words. Importantly, machine language lacks emotion. Thus, while machines currently can write novels, using randomizing formulae, in a society of their own they surely would have no *need* to create an artifical reality built on words—which literature is. The gems of our literature, full of turbulent emotions, would baffle them. Literature is for organic human beings like us, full of emotions as we are (10).

Just as non-organic humans would not need to eat or excrete, to breathe or sleep, they would not need literature. While there would not be literature as we currently know it, our non-organic descendants may succeed in moving language to a new place. Though they will not *need* literature, they may *choose* to create something like it—something really new.

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Notes

The links below are to the resources at Internet Archive.

1 E. B. Tylor, *Primitive Culture*. vol 1. (London, 1871), p. 271. See Chapters 5-6, "Emotional and Imitative Language," pp. 145-217, *passim*. Tylor notes the early "tyranny of speech" (and language) over the human mind. Human reality gets codified into words, and we can live much of our lives within that symbolic reality, which covers us like a cocoon. A searchable version of vol. 2 also is available. Links to many of the author's other works at Internet Archive are available in the compilation Selected Writings of Edward Burnett Tylor. In this essay we use "machine language" to mean, generally, computer languages.

2 Edward Burnett Tylor: In addition to *Primitive Culture* referenced in the note above, see his *Anthropology* (New York, 1899), Chapters 4-6 on language, pp. 114-166.

Charles Darwin: The Expression of the Emotions in Man and Animals, by Charles Darwin (London, 1915; first published in 1872). See also below in the text.

Franz Boas: Chapter 4, "Language," pp. 124-145, from *General Anthropology* (New York, 1938), F. Boas, editor. Links to many of the author's other works at Internet Archive are available in the compilation Selected Writings of Franz Boas.

Alfred Louis Kroeber: Chapter 6, "Language," pp. 206-251, from *Anthropology* (New York, 1948; first published in 1923). Links to many of the author's other works at Internet Archive are available in Writings on Historiography.

3 For example, these excellent links and their sublinks, at Wikipedia:

Human Language
Programming Language

4 *Anthropology* (New York, 1899), Chapters 4-6 on language, pp. 114-166.

> Passages from Tylor:
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> "One kind of sounds used by men as signs, consists of emotional cries or tones. Men show pain by uttering groans as well as by distortion of face; joy is expressed by shouts as well as by jumping; when we laugh aloud, the voice and the features go perfectly together. Such sounds are gestures made with the voice, sound-gestures, and the greater number of what are called interjections are of this class. By means of such cries and tones, even the complicated tempers of sympathy, or pity, or vexation, can be shown with wonderful exactness. Let any one put on a laughing, sneering, or cross face, and then talk, he may notice how his tone of voice follows; the attitude of features belonging to each particular temper acts directly on the voice, especially in affecting the musical quality of the vowels. Thus the speaker's tones become signs of the" [p. 120] emotion he feels, or pretends to feel. That this mode of expression is in fact musical, is shown by its being imitated on the violin, which by altering its quality of tone can change from pain to joy. The human voice uses other means of expression belonging to music, such as the contrast of low and loud, slow and quick, gentle and violent, and the changes of pitch, now rising in the scale and now falling. A speaker, by skilfully managing these various means, can carry his hearer's mind through moods of mild languor and sudden surprise, the lively movement of cheerfulness rising to eager joy, the burst of impetuous fury gradually subsiding to calm. We can all do this, and what is more, we do it without reference to the meaning of the words used, for emotion can be expressed and even delicately shaded off in pronouncing mere nonsense-syllables. For instance, the words of an Italian opera in England are to a

> great part of the audience mere nonsense-syllables serving as a means of musical and emotional expression." (p. 121).
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> ... Here a very interesting question arises, on which every student has the means of experimenting for himself. How far are the communications of the lower animals, by their actions and sounds, like this natural language of mankind? Every one who attends to the ways of beasts and birds is sure that many of their movements and cries are not made as messages to one another, but are merely symptoms of the creature's own state of mind; for instance, when lambs frisk in the meadow, or eager horses paw in the stable, or beasts moan when suffering severe pain. Animals do thus when not aware that any other creature is present, just as when a [p. 123] man in a room by himself will clench his fist in anger, or groan in pain, or laugh aloud. When gestures and cries serve as signals to other creatures, they come nearer to real signs. The lower animals as well as man do make gestures and cries which act as communications, being perceived by others, as when horses will gently bite one another to invite rubbing, or rabbits stamp on the ground and other rabbits answer, and birds and beasts plainly call one another, especially males and females at pairing-time. So distinct are the gestures and cries of animals under different circumstances, that by experience we know their meaning almost certainly. Human language does not answer its purpose more perfectly than the hen's cluck to call her chickens, or the bellow of rage with which the bull, tossing his head, warns off a dog near his paddock. As yet, however, no observer has been able to follow the workings of mind even in the dog that jumps up for food and barks for the door to be opened. It is hard to say how far the dog's mind merely associates jumping up with being fed, and barking with being let in, or how far it forms a conception like ours of what it is doing and why it does it. Anyhow, it is clear that the beasts and birds go so far in the natural language as to make and perceive gestures and cries as signals. (pp. 122-123).
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> "It proves that so far as language can be traced to its actual source, that source does not lie in some lost gifts or powers of man, but in a state of mind still acting, and not above the level of children and savages. The origin of language was not an event which took place long ago once for all, and then ceased entirely. On the contrary, man still possesses, and uses when he wants it, the faculty of making new original words by choosing fit and proper sounds. But he now seldom puts this faculty to serious use, for this good reason, that whatever language he speaks has its stock of words ready to furnish an expression for almost every fresh thought that crosses his mind." (p. 131).

5 Boas, "Language," p. 124, from *General Anthropology* (New York, 1938). Also: "In so far as a specific bodily reaction is related to similar sense experiences, it will excite in other animals of the same group, but not necessarily of the same species, the memory of similar situations, of an emotional rather than of a specific descriptive character. The range of experiences is very wide. The animal cry may convey the memory of danger and flight, of food and satiation of hunger, but nothing more definite. No case has been observed in which an animal represents a specific experience by visual, tactile, or auditory signs," *ibid.*

6 Boas, *ibid.*, p. 125. Also: "With the clearer differentiation of situations, these movements have multiplied and led to a gesture language which in its primitive form presumably consisted solely of intensified innervations but which has developed everywhere in such a manner that it accompanies articulate speech. We cannot tell whether gesture language preceded speech or developed with it. In its simpler forms it consists of movements which correspond to the weak innervation accompanying thought and speech. For the development of both gesture language and speech it was necessary that man should have acquired the ability to express specific experiences. To make this possible the number of significant symbols must have increased enormously. The situations that present themselves in the course of life are so varied that differentiation never proceeded to such a degree that each experience was expressed by means of a single acoustic or visual symbol, except in cases in which the same situation, distinct from all others, presented itself with great frequency. In fact such differentiation would be impossible on account of the uniqueness of every experience. In gestures as well as in spoken language large numbers of situations are expressed by the same formal expression. In other words, a grouping together of similar experiences persisted, and these have found their representation in symbols," *ibid.*

7 Alfred Louis Kroeber: Chapter 6, "Language," p. 248, from *Anthropology* (New York, 1948; first published in 1923) "...Language is primarily a mechanism or means, whereas in culture ends or purposes obtrude more. It is thus easier to view linguistic phenomena dispassionately. Grammars and dictionaries, for instance, are evidently the result of self-consciousness arising about speech which has previously been mainly unconscious. They may be roughly compared to social formulations like law codes or written constitutions or philosophical systems or religious dogmas, which typically begin also as representations of usages or beliefs already in existence (p. 250).

> "Codes, dogmas, and grammars are thus normally reflections, secondary rather than primary causes. Such influence as they have is mainly in outward crystalization. They produce an appearance of permanence. In the field of speech, it is easy to recognize that it is not grammarians that make languages, but languages that make grammarians. The analogous process evidently holds for culture. Lawgivers, statesmen, religious leaders, discoverers, inventors seem to shape civilization when actually they much more express it. The complex and often obscure forces that shape culture also mold the so-called creative leaders of society as essentially as they mold the mass of humanity. Progress, so far as it exists objectively, can be construed as something that happens rather than as something we make as we set out to make it. Our frequent assumption to the contrary is probably the result of a reluctance to realize our individual near-impotence as regards remodeling the culture we live in, as contrasted with the overpowering molding we receive from it. But how much does any one of us create or shape or alter his language? Culture no doubt is a bit more malleable; but the comparison with speech should make us cautious not to overrate our capacity for initiative.
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> Undoubtedly we do have social influence as individuals. It is an influence on the fortune and the careers of other individuals, sometimes on larger segments of society, and it is concerned largely with aims of personal security, relative dominance, or affection among ourselves. We also have many choices among the alternatives contained in our culture and in our speech. To some extent we can manipulate certain alternatives and ambiguities of the culture in our personal favor, or in the direction of our ideals. Now and then, perhaps, we succeed in establishing, with the support of others, some altered behavior or idea or idiom, some novel twist of custom or phrase. That seems to describe the range of our exertion of influence on the form or content of those mass products and mass influences which we call civilization and language," *ibid*. p. 251.

8 Native data storage for humans is based on memory. In old age, memory seems to get overwritten, and retrieval is not so fast or clean. From direct observation it appears that things are stored "like with like" in some way. For example, when cleaning my attic, each object that I looked at or handled seemed to have memories associated with it. Within a few minutes, I was entirely in a "House of Dreams" created by memories which were triggered by the objects. The data about each object was retrieved with other memories as attachments.

9 Tylor, *Primitive Culture*, volume 2, pp. 403-404.

10 Indeed, one way we humans use literature is to cover our own internal reality with a fictional one, for a while. When we open a novel and start reading, our own world gets pushed aside temporarily. We figuratively pass "through the looking-glass" or fall "down the wormhole" into another reality. Just reading certain words may also trigger entirely unintended associations and reminiscences.

Humanutics Series, at Internet Archive.